TECHNICAL MEMORANDUM

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To: Susan Teefy, P.E.
Alameda County Water District

Project No.: 0008.0030

From: Issam Najm

Project: Minimizing Bromate Formation with CO_2 Addition

Re: Testing Plan for Comparing the Direct and Indirect CO_2 Addition Schemes

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As part of the CalFed-funded project titled: "Bromate Formation with CO_2 Addition", the impact of CO_2 addition method is to be investigated. The two CO_2 addition methods include the "Direct" method and the "Indirect" method. The Indirect method refers to the addition of CO_2 to a carrier water stream under elevated pressure, followed by injection of the combined CO_2-water stream into the water line entering the ozone contactor. The Direct method refers to the injection of CO_2 gas directly into the ozone-gas line entering the diffuser grid at the bottom of the ozone contactor. One of the objectives of the CalFed project is to determine whether the difference between the two CO_2 feed methods has an impact on the levels of bromate formed upon ozonation of bromide-containing waters.

The CO_2 feed system at TP2 has been modified to allow for the Direct CO_2-feed into Train #2, while the Indirect CO_2-feed method is utilized for Train #1. This memorandum includes a brief testing plan for evaluating the impact of CO_2 feed method on bromate formation at TP2.

Testing will be conducted over a two-day period. During the first day, the transferred ozone dose will be set at about 1.5 mg/L. During the second day, the ozone dose will be increased to about 2.5 mg/L. For each ozone dose (i.e., during each day of testing), four CO_2 doses will be applied equally to each train. The four doses are 0 mg/L, 10 mg/L, 20 mg/L, and 40 mg/L. The sequence of doses tested should be 10 mg/L, then 20 mg/L, then 40 mg/L, and then 0 mg/L. This sequence is important because it is influenced by the decline in raw water pH from about 9.0 at 8 AM to about 8.0 at 3 PM. It is desirable to conduct the 10-mg/L testing between 8:30 AM and 10:00 AM, the 20-mg/L testing between 10:00 AM and 11:30 AM, the 40-mg/L testing between 11:30 AM and 1:00 PM, and the 0-mg/L between 1:00 PM and 2:30 PM.

For each CO_2 dose tested, the following sequence of activities should be conducted:

1. Adjust the CO_2 dose to the target value in each contactor.
2. Allow the water to equilibrate with the new CO_2 dose for a period of one (1) hour

3. Sample the raw water for the following parameters:
    - pH
    - Temperature
    - Alkalinity
    - Conductivity, and
    - Bromide.

    The pH and temperature need to be analyzed immediately. However, the alkalinity and conductivity samples may be stored for later analysis.
4. Sample the effluent of each of the five chambers in each contactor for the following:
    - pH
    - Ozone Residual
    - Bromate (with a quenching agent present in the bottles)
5. Sample the effluent of the 5th chamber in each contactor for bromate analysis with no quenching agent present in the bottles.
6. Repeat Step 1 for the next CO_2 dose.